IZMIR DEMOCRACY UNIVERSITY SOCIAL SCIENCES JOURNAL (IDUSoS)
Cilt/Volume:8 Sayı/Issue: 1 Sayfa/Page: 77-98

CURRENCY CONNECTEDNESS BETWEEN DEVELOPED AND EMERGING MARKETS: A TVP-VAR-BASED ANALYSIS

Arş. Gör. Bünyamin ÖZKÜR[1]

Prof. Dr. Doğan UYSAL[2]

Doç. Dr. Can KARABIYIK[3]

ABSTRACT

This study examines currency connectedness between developed and emerging market economies from a dynamic perspective, aiming to fill a significant gap in the literature. While existing research predominantly focuses on developed economies, this study highlights the growing influence of emerging market currencies within the global financial system. The analysis employs currency indices—namely the U.S. Dollar Index (DXY), Euro Index (InvEUR), and Swiss Franc Index (CHF)—to represent developed markets, alongside the MSCI Emerging Markets Currency Index (MSCI EM) to capture emerging market dynamics. By using currency indices instead of individual exchange rates, the study offers a more holistic and comprehensive analysis. A high-frequency dataset spanning the period from May 12, 2023, to April 16, 2025, is utilized. The analysis, conducted using the TVP-VAR-based Dynamic Connectedness Index methodology, reveals that the interconnectedness among currencies intensifies notably during periods of financial uncertainty, though remains limited in the broader sample. The total connectedness level is empirically calculated at 24%, indicating that 24% of currency volatility is attributable to external shocks. Furthermore, the decline in volatility spillovers observed from the second half of 2023 onward is interpreted as a significant indicator of reduced financial contagion and improved market functioning.

Keywords: Currency Connectedness, Financial Contagion, Dynamic Connectedness, Spillover Decomposition, TVP-VAR.

Jel Codes: F31, F38, G15.

[1] Manisa Celal Bayar Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, İktisat Bölümü, İktisat Teorisi ABD, e-posta: bunyamin.ozkur@cbu.edu.tr

[2] Manisa Celal Bayar Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, Ekonometri Bölümü, Ekonometri ABD, e-posta: dogan.uysal@cbu.edu.tr, ORCID: 0000-0001-9406-0757

[3] Manisa Celal Bayar Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, İktisat Bölümü, İktisadi Gelişme ve Uluslararası İktisat ABD, e-posta: c_karabiyik@hotmail.com, ORCID: 0000-0002-7255-7946

Makale Gönderim Tarihi (Manuscript Submit Date): 06.05.2025, Kabul Tarihi (Accepted Date): 04.06.2025, Basım Tarihi (Published Date): 30.06.2025

1. INTRODUCTION

The value of national currencies in international markets serves as a reflection of the underlying economic structure to which they belong. The international valuation of a currency is determined by the functioning of a system shaped by numerous factors such as institutional infrastructure, legal framework, freedom of expression, financial development, production capacity, and education. In addition to these internal dynamics, the value of currencies—particularly those of emerging market economies—is also influenced by external factors such as the balance of payments, foreign trade, capital flows, geopolitical crises, diplomatic disputes, and the monetary policies of other economies. In short, a country's currency is more than just a medium of exchange within its domestic market. In this regard, a currency functions as a crucial indicator affected by commercial, economic, and diplomatic relations and is arguably the most significant asset price within the globalized economic system (Rose, 2011, p. 652). Beyond its role in financial markets, foreign exchange constitutes a vital link between the real and financial sectors (Mittal, Sehgal, & Mittal, 2019, p. 2).

Operating 24 hours a day and facilitating vast international information flows via exchange rates, foreign exchange (forex) markets are truly global in nature (Baruník, Kočenda, & Vácha, 2017, p. 41). The acceleration of financial liberalization, along with advancements in information technologies, has spurred the rapid development of financial technologies (fintech). These technologies enable a range of financial transactions—particularly international money transfers—to be executed within seconds. This facilitates speculative trading, thereby increasing both transaction volume and the frequency of currency shocks. Such shocks can be transmitted from one economy to another. Based on these dynamics, it is posited that the foreign exchange market lies at the core of international shock transmission and that a volatility spillover effect exists among currencies (Mittal et al., 2019, p. 2). This phenomenon is referred to as currency connectedness.

The role of emerging market economies within the global economic system has been expanding steadily. This study aims to investigate the degree of currency connectedness between reserve currencies of developed economies—such as the Euro, Swiss franc and USA dollar and those of emerging market economies. The primary objectives of this study are: (a) to determine the magnitude of shocks transmitted among currencies, and (b) to identify the periods in which total currency connectedness increases or decreases over time. The findings of this study are of particular relevance for both investors and policymakers, as they may inform the development of effective financial hedging strategies and policy interventions.

2. THEORETICAL FRAMEWORK

Forex markets are decentralized trading platforms that operate without a single physical or electronic exchange. They are characterized by several features: 24-hour trading (excluding weekends), susceptibility to central bank interventions, and low profit margins. Due to its low spreads and high liquidity, the forex market is considered the financial market closest to the ideal of perfect competition (Diebold & Yılmaz, 2015, p. 153). Uniquely, it facilitates not only speculation on currency values but also plays a critical role in enabling global trade and investment. In this regard, the forex market is more directly intertwined with the global economic system than stock or bond markets (Diebold & Yılmaz, 2015, p. 153).

Moreover, volatility spillovers within the forex market play a decisive role in investors' decision-making processes. However, financial analysts face significant challenges in obtaining meaningful insights and forecasts about currency connectedness, primarily due to the high volatility that makes forex markets difficult to predict. This is largely attributable to the greater sensitivity of exchange rates to monetary policy relative to equity or bond markets (Baruník et al., 2017).

As previously noted, volatility spillovers in forex markets influence the behavior of portfolio investors and trade participants, thereby affecting macroeconomic variables such as investment and production. For instance, positive currency connectedness shocks increase unsystematic risk, which diminishes the benefits of international portfolio diversification by influencing the decisions of market participants (Kanas, 2000, pp. 447–448). In addition, currency connectedness plays a critical role not only in financial decision-making within monetary and non-monetary portfolios but also in the success of international trade actors (Shahzad, Arreola-Hernandez, Rahman, Uddin, & Yahya, 2020, p. 1). Exchange rate shifts triggered by external shocks transmitted across currencies can alter the balance of international trade. Accordingly, a deeper understanding of currency connectedness can reduce market uncertainty and contribute to the conditions necessary for financial stability. While financial crises are often unpredictable, the transmission of shocks associated with such crises tends to exhibit certain common characteristics (Reinhart & Rogoff, 2008). For this reason, various methods have been developed to investigate how such shocks are transmitted.

The dynamic relationships among currencies traded in the forex market can influence all components of an economy, both at micro and macro levels, and can affect governmental decision-making processes. Strong currency connectedness can create volatility in foreign exchange markets, which may either constrain hedging opportunities or pave the way for

speculative gains (Baklacı, Aydoğan, & Yelkenci, 2020, p. 1). Moreover, profit margins for long-term investments and national competitiveness can vary depending on exchange rate volatility. Thus, investors and corporations closely monitor general price levels and interest rates across countries. Economic agents involved in foreign exchange transactions can derive benefit by better understanding short-term exchange rate movements and monitoring currency connectedness (Mittal et al., 2019, p. 2).

Particularly in emerging markets with high external dependence, exchange rate fluctuations may lead to various adverse outcomes such as inflationary pressures, a decline in net worth for firms with foreign currency debt, bankruptcies, and sharp drops in employment. These risks prompt policymakers to closely monitor foreign exchange markets. For instance, a financial shock in a reserve currency economy can influence exchange rates in other countries by redirecting capital flows or increasing their volume through the forex market. Consequently, key macroeconomic variables such as exchange rates, trade balances, and inflation can be affected.

To what extent are currency markets interconnected? This question attracts interest from policymakers, investors, and economists alike. According to Bubák, Kočenda, and Žikeš (2011), economies with underdeveloped financial systems may suffer more severely from currency connectedness. Economies with more stable, deep, efficient, and accessible financial systems are generally less vulnerable to external shocks. Mittal et al. (2019) also argue that there is a strong relationship between currency connectedness and international portfolio flows. Therefore, the level of financial integration—which significantly influences capital mobility—also plays a crucial role in the interactions among currencies.

Currency connectedness tends to intensify in the case of industrialized economies whose currencies are considered reserve currencies, due to their central role in global monetary policy formulation. For example, quantitative easing policies adopted by major central banks such as the Federal Reserve (Fed) and the European Central Bank (ECB) following the global financial crisis led to outcomes such as asset bubbles, foreign exchange abundance, and overvalued domestic currencies in emerging markets (Medvedev, Rama, & Ikeda, 2019). Moreover, international interest rate differentials can influence the time-varying behavior of exchange rates (Diebold & Yılmaz, 2015, p. 156). When the distinction between developed and emerging market economies is considered, significant differences in monetary policy approaches are evident. During financial crises, for instance, emerging markets may raise interest rates to attract capital, whereas developed economies typically implement expansionary measures to

stimulate demand (Karabıyık, 2020). These divergent monetary policies create interaction between the national currencies of developed and developing economies. According to Shousha (2019), for instance, an appreciation in the U.S. dollar leads to declines in GDP, investment, and private sector credit levels in emerging markets. Thus, U.S. dollar volatility is transmitted to emerging market currencies. However, contrary to the Mundell-Fleming model, this transmission occurs not through net exports but via changes in the financial conditions of emerging markets. Beginning in the late 20th century, emerging market currencies entered an appreciation trend fueled by large-scale capital inflows. Between 2004 and the collapse of Lehman Brothers, many emerging market currencies appreciated by 40–50%. Following the collapse, these gains vanished, and emerging market currencies experienced daily depreciations of up to 5% (Ramos, 2019). Concerns about Fed rate hikes and the depreciation of emerging market currencies dominated this period. These developments underscore the close linkage between developed economies' monetary policies and emerging market currencies.

The literature on exchange rates is extensive, but most studies focus on developed economies. However, the global economic system is undergoing transformation as emerging markets assume increasingly significant roles. Developed markets are no longer the primary holders of foreign reserves, and this shift is becoming more evident within the forex market (Menkhoff, 2013, p. 1187). Accordingly, there is growing academic interest in the influence of emerging market economies on the global economic order. For example, Bubák et al. (2011) emphasize that despite increasing integration with developed markets, emerging European economies remain under-researched. Their study addresses this gap by examining currency connectedness between the currencies of developed and emerging European markets. Building on this foundation, the current study broadens the scope by investigating volatility spillovers not only between the euro and emerging currencies, but also among the U.S. dollar, Swiss franc, and emerging market currencies. In doing so, it seeks to fill an important gap in the literature on developed–emerging currency linkages.

Furthermore, the existing literature on currency connectedness commonly uses exchange rates measured against the U.S. dollar. As a result, the U.S. dollar itself—despite its central role in global monetary policy—cannot be directly included in the model, and its effects are measured only indirectly via currency pairs. In contrast, this study utilizes global currency indices to represent the currencies under investigation, rather than bilateral exchange rates. This approach enables the direct modeling of currency values and allows for a broader and more meaningful analysis, thereby contributing to the literature.

3. LITERATURE REVIEW

Empirical studies on volatility spillovers in the forex market trace back to Engle, Ito, and Lin (1990), who introduced two meteorological metaphors—the "Meteor Shower" and the "Heat Wave" hypotheses—to explain daily volatility transmission. According to the Heat Wave hypothesis, daily fluctuations in the forex market are similar to localized weather patterns—for instance, a hot day in New York might be succeeded by another warm day there, but this pattern is unlikely to apply to Tokyo. In other words, forex movements are country-specific and not interconnected. The Meteor Shower hypothesis, in contrast, posits that if a meteor shower is observed in New York, one is also expected in Tokyo, implying interconnectedness across countries. This seminal study sparked a substantial body of research examining various aspects of volatility and connectedness in currency markets.

Subsequent literature on forex volatility spillovers and connectedness has primarily focused on: (i) volatility transmission among different currency pairs, (ii) spillovers across different trade regions, and (iii) asymmetric behaviors in currency movements. The studies summarized below are organized according to these categories.

Kavli and Kotze (2014) analyzed volatility and return spillovers for 14 developed and emerging market currencies over the 1997–2011 period using the Diebold and Yılmaz (2012) spillover index. They found that return spillovers increased steadily over time and responded moderately to economic shocks, while volatility spillovers were more sensitive to such shocks. Their results also suggest that volatility connectedness remained relatively elevated following the 2008 global financial crisis.

Diebold and Yılmaz (2015) employed their own spillover index methodology to examine the connectedness among highly convertible currencies, including the euro, British pound, Swiss franc, Norwegian krone, Swedish krona, Japanese yen, Australian dollar, New Zealand dollar, and Canadian dollar. The study used daily USD exchange rates to measure currency values and found that volatility spillovers intensified during periods of financial turbulence.

Do, Brooks, Treepongkaruna, and Wu (2016) studied the link between equity and forex markets using a Fractionally Integrated Vector Autoregressive (FIVAR) model, incorporating skewness and kurtosis along with volatility. Their findings revealed strong and positive connectedness between equity and currency markets across developed and emerging economies.

Elsayed, Gozgor, and Lau (2020) adopted a novel approach to examine connectedness between three major cryptocurrencies (Bitcoin, Litecoin, Ripple) and nine major fiat currencies during

the 2013–2018 period. Using the Diebold and Yılmaz (2012) methodology, they found strong spillovers between Bitcoin and Litecoin. A Bayesian graphical structural vector autoregressive model further showed that Bitcoin's value was significantly influenced by lagged values of the Chinese yuan, while Ripple's movements were closely linked to the past values of both Bitcoin and Litecoin. They also identified significant effects of Ripple and the Chinese yuan on Litecoin. The study concludes that there is strong interaction among cryptocurrencies, although no significant interaction was found between cryptocurrencies and fiat currencies—except the Chinese yuan.

Bubák et al. (2011) investigated the dynamic relationships between Central European currencies (Czech koruna, Hungarian forint, Polish zloty) and the EUR/USD pair using daily data from 2003–2009. Using a HAR-GARCH model, they found that exchange rate volatility was influenced by both own-lagged values and those of other currencies. Employing the Diebold and Yılmaz (2009) spillover index, they observed that currency connectedness intensified during periods of market uncertainty.

Greenwood-Nimmo, Nguyen, and Rafferty (2016) examined G10 currency connectedness using an empirical network model derived from the Diebold and Yılmaz (2012) spillover index. Using daily data from 1999–2014, they found that volatility and skewness spillovers increased during financial crises.

Chow (2018) conducted a regional study measuring the interactions between the Chinese yuan and Asian currencies, including the Korean won, Malaysian ringgit, Japanese yen, Thai baht, Taiwanese dollar, Indonesian rupiah, Philippine peso and Singapore dollar. Euro and Australian dollar were also included. Using the Diebold and Yılmaz (2012) methodology and USD-based exchange rates, the study covered the period from September 6, 2010, to September 1, 2017, and found substantial cross-border spillovers in Asian forex markets.

Hung (2020) examined the connectedness of European currencies from Romania, Crotia, the Czech Republic and Hungary using daily data from 2008–2017. Based on the Diebold and Yılmaz (2012) framework, the study found increasing bidirectional volatility spillovers among these currencies, with the Czech koruna identified as the most affected.

Baruník et al. (2017) focused on asymmetric volatility connectedness in the forex market using daily data from 2007–2015. Expanding the Diebold and Yılmaz (2012) approach, they decomposed total volatility into good (positive shocks) and bad (negative shocks) components. Their analysis, using USD exchange rates for currencies such as the Australian dollar, British

pound, Canadian dollar, euro, Japanese yen, and Swiss franc, revealed significant heterogeneity in the shocks transmitted and received across currencies.

Mittal et al. (2019) studied dynamic and asymmetric connectedness among 15 emerging market currencies—including those of Brazil, Russia, India, South Africa (BRIS countries), and Turkey—using daily data from 2001 to 2008. Applying ADCC-EGARCH and Diebold and Yılmaz (2012) methodologies, they found that connectedness among BRIS currencies intensified during crisis periods.

Shahzad et al. (2020) employed the wavelet coherence technique to examine asymmetries in connectedness among major currencies, including the euro, British pound, Swiss franc, Canadian dollar, Japanese yen, and Australian dollar. Their results indicate that volatility and cross-currency effects increased significantly during the global financial crisis.

Baklacı et al. (2020) applied a bivariate VAR-BEKK-GARCH model to examine asymmetric connectedness among currencies during open and closed trading hours in Tokyo, London, and New York stock markets. They emphasized that the literature predominantly focuses on major currencies and often overlooks the dynamics among small and exotic currencies. Their study, covering 11 currencies—including the Hong Kong dollar and Mexican peso—from 2009 to 2017, stands out by using high-frequency data (daily, 15-minute, and 5-minute intervals), making it one of the most granular studies in the volatility spillover literature. Their findings show that intraday connectedness is significantly stronger than daily connectedness, and that during trading hours, small and exotic currencies often play a more pivotal role than major currencies in volatility transmission.

Almansour, Uddin, Elkrghli, and Almansour (2023) investigated volatility spillovers among 12 cryptocurrencies and 8 major currency pairs using the TVP-VAR model and the Diebold and Yılmaz (2014) methodology. Their dataset spans from November 10, 2017, to January 18, 2022. Cryptocurrencies analyzed included Bitcoin, Ethereum, Tether, Binance Coin, Cardano, Ripple, Luna, Dogecoin, Chainlink, Litecoin, Bitcoin Cash, and TRON. Major currency pairs included EUR/USD, USD/CHF, USD/CAD, EUR/JPY, AUD/USD, CHF/JPY, NZD/USD, and CNY/USD. The study found that Ethereum, Bitcoin Cash, Litecoin, Bitcoin, TRON, Cardano, and Ripple were the main transmitters of shocks among cryptocurrencies. Similarly, EUR/USD, AUD/USD, and NZD/USD emerged as the primary transmitters among fiat currencies.

He, Cheng, Wang, and Luo (2025) examined dynamic connectedness among BRICS currencies using a dataset spanning from July 20, 2005, to October 31, 2023. Utilizing a TVP-VAR

framework, their findings revealed that changes in total and net connectedness were closely associated with major economic, financial, and political events. The study identified the South African rand as a consistent net transmitter, while the Indian rupee and Chinese yuan acted as persistent net receivers. The roles of the Brazilian real and Russian ruble, in contrast, shifted over time.

4. DATA

In empirical research, the indicators used to represent variables are of critical importance for the accuracy of the findings. Likewise, in studies on currencies, the method used to measure currency values can significantly influence the results. Common approaches to measure currency values include exchange rates (currency pairs) and indices. Most studies tend to use exchange rates, defined as the relative value of one currency against another. For instance, Baruník et al. (2017) and Chow (2018) measure the currencies in their studies in terms of U.S. dollars. However, in such cases, the U.S. dollar—despite being the most closely monitored currency in global monetary policy—cannot be directly included in the model, and its effects can only be captured indirectly through exchange rates.

In this study, instead of using currency pairs, global currency indices are employed to represent currency values. This allows for broader and more comprehensive measurement by avoiding the limitation of referencing a single national currency such as the U.S. dollar, euro, or Swiss franc. As a result, the U.S. dollar is modeled directly, and the use of an index for emerging market currencies offers a more holistic indicator. The MSCI Emerging Markets Currency Index (MSCI EM) is used to represent the currencies of emerging market economies. Employing indices to represent entire country groups is a widely accepted approach. For example, Walid, Chaker, Masood, and Fry (2011) examined the conditional correlation between U.S. stock markets and those of five emerging Islamic economies using the MSCI Islamic Equity Index.

Another common limitation in the literature is the use of low-frequency data series. Low-frequency datasets, especially for major currencies, may fail to adequately reflect trading activity and are unable to capture daily interactions (Shahzad et al., 2020, p. 2). High-frequency data, on the other hand, offer better modeling possibilities for volatility forecasting (Menkhoff, 2013, p. 1201; Baruník et al., 2017, p. 42) and enable more robust inferences about volatility spillovers (Bubák et al., 2011, p. 2830).

The dataset used in this study consists of high-frequency daily data. The analysis includes the daily values of the U.S. Dollar Index (DXY), the euro index (InvEUR), the Swiss franc index (CHF), and the MSCI Emerging Markets Currency Index (MSCI EM) for the period between May 12, 2023, and April 16, 2025. Each currency in the data set comprises 504 observations. All data were obtained from investing[4] web site. For the calculation of volatility, the Parkinson (1980) method was employed, which uses the highest and lowest values recorded for each currency within a trading day.

Figure 1: Daily Currency Market Volatilies

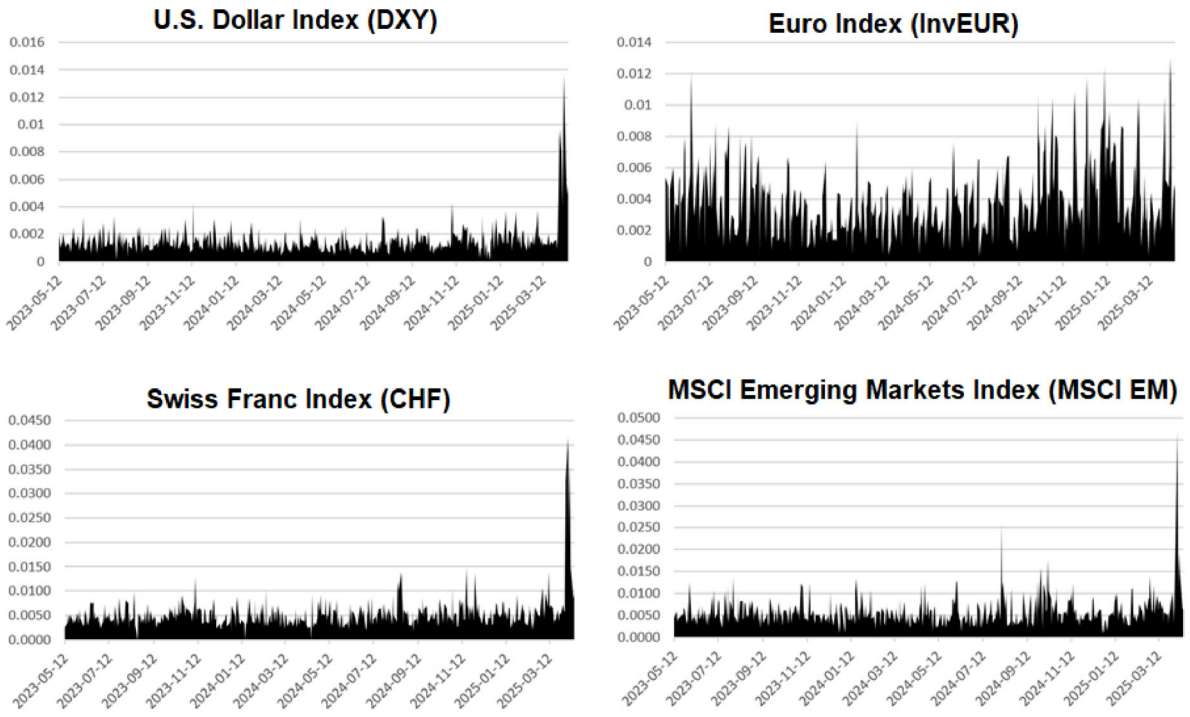


Figure 1 presents the calculated daily currency market volatility values. When all currencies are considered collectively, significant fluctuations are observed in global markets at the end of March and the beginning of April 2025, driven by developments in the U.S. economy. Key sources of this turbulence include the Federal Reserve's interest rate policies, rising recession concerns, and, notably, the trade policies pursued by President Donald Trump. In particular, the implementation of new tariffs targeting China and other countries heightened fears of a global trade war. These policies reintroduced inflationary pressures into the global economic agenda and increased uncertainty surrounding the Fed's future actions.

[4] https://tr.investing.com/

Throughout the observation period, elevated volatility is consistently observed in the InvEUR index. This may be attributed to the complex structure of the euro. As the currency of an economic union that includes major economies such as Germany and France, and owing to its multinational nature, the euro is subject to divergent impacts from the internal political and economic developments of its member states.

Table 1: Descriptive Statistics

	MSCI EM	InvEUR	CHF	DXY
Mean	0.005769	0.003912	0.005313	0.001572
Median	0.005141	0.003570	0.004779	0.001368
Maximum	0.047087	0.012991	0.041490	0.013744
Minimum	0.000863	0.000369	0.000000	0.000102
Std. Dev.	0.003400	0.002236	0.003409	0.001147
Skewness	4.661328	1.066412	5.759383	5.282928
Kurtosis	48.50703	4.430663	51.76615	44.27327
Observations	504	504	504	504

Table 1 presents the descriptive statistics for the daily volatilities of the MSCI EM, InvEUR, CHF, and DXY indices. The results align with the common perception that emerging market economies are characterized by high levels of imbalance, volatility, and instability. However, it is notable that the Swiss franc (CHF)—the currency of one of the world's most stable economies—exhibits volatility levels comparable to those of emerging market currencies. Among all currencies examined, the U.S. dollar demonstrates the lowest average volatility, supporting the claim that it possesses a relatively stable structure.

5. METHODOLOGY AND FINDINGS

In the literature, two primary empirical approaches are used for estimating volatility spillovers: GARCH-based and VAR-based models. Among the VAR-based methodologies, one of the most prominent is the spillover index developed by Diebold and Yilmaz (2009) and later revised by Diebold and Yilmaz (2012). This approach is considered groundbreaking and offers several advantages over other volatility spillover methodologies used in prior studies (Roy & Roy,

2017, p. 372). Econometric techniques developed for volatility spillover analysis generally aim to identify the source of volatility transmission across countries or markets. However, the Diebold and Yilmaz (2012) spillover index methodology stands out in its ability to simultaneously visualize spillover dynamics and changes in total volatility over time through a spillover table. This dual capacity enables a more detailed analysis of periods of financial stress. The methodology functions by decomposing forecast error variances, thereby allowing for the measurement of volatility transmission across markets.

Antonakakis and Gabauer (2017) aimed to improve upon the Diebold and Yilmaz (2012) framework. The estimation technique they proposed enhances the original methodology in three key respects: (1) it eliminates the need to arbitrarily set the rolling window size; (2) it avoids data loss; (3) it is robust to outliers.

This enhanced approach is known as the TVP-VAR-based Dynamic Connectedness Index. The TVP-VAR (Time-Varying Parameter Vector Autoregression)-based methodology enables a multidimensional analysis of volatility spillovers. It allows for the quantification and graphical presentation of the percentage impact that each currency exerts on others. The graphical representation of this dynamic relationship illustrates changes in total connectedness over time. In this study, the TVP-VAR-based Dynamic Connectedness Index methodology is employed.

Through this method, a volatility spillover table is generated, listing the pairwise volatility spillovers between each pair of markets or currencies. The table provides a clear representation of the degree of spillover, the extent to which volatility is transmitted from one market to another, and the share of internally generated versus externally received volatility. It also presents bilateral dynamic connectedness measures and the Total Connectedness (TC) index.

In the matrix-formatted spillover table, the rows represent the volatility received by currency *i* (Connectedness from Others), while the columns represent the volatility *transmitted* by currency *i* to others (Connectedness to Others). Accordingly, the volatility received by currency *i* from currency *j* is found at the intersection of row *i* and column *j*. The final column of the table displays the total percentage of external shocks received by each currency—these are the spillover index values. The spillover index for a currency *i* is calculated as the ratio of two sums: the numerator is the sum of all off-diagonal entries in row *i* (i.e., excluding the diagonal self-effect), while the denominator is the sum of all entries in that same row. These values are presented in the “Connectedness from Others” column. Diagonal values of the matrix capture the idiosyncratic shocks specific to each currency.

Conversely, the Connectedness to Others measure—found in the second-to-last row of the table—reflects the proportion of forecast error variance in other currencies that is attributable to shocks originating from currency *i*. This value is computed excluding the internal shock of currency *i*. The Net Connectedness for each monetary index is then derived by subtracting the Connectedness from Others from the Connectedness to Others. This value reflects the net external shock contribution of each currency to the system. Continuing with the analysis, Table 2 presents the estimated volatility spillover values.

Table 2: Volatility Spillover Values

	DXY	InvEUR	MSCI_EM	CHF	*Connectedness from Others*
DXY	71.43	5.5	10.67	12.41	28.57
InvEUR	5.01	85	4.67	5.32	15
MSCI_EM	7.14	4.18	75.56	13.12	24.44
CHF	13.79	5.45	7.64	73.13	26.87
Connectedness to Others	25.94	15.12	22.98	30.85	94.89
Connectedness İncluding Own	97.37	100.12	98.54	103.98	
Net Connectedness	*-2,63*	*0.12*	*-1.46*	*3.98*	*TC=%24*

The “Connectedness from Others” column in the volatility spillover table indicates the percentage of gross directional volatility spillovers received by each currency from others. According to these results, 28.57% of the volatility in the DXY index, 15% in the InvEUR index, 24.44% in the MSCI EM index, and 26.87% in the CHF index originates from external shocks. These findings suggest that among all currencies analyzed, the U.S. dollar index (DXY) is the most exposed to external volatility. The net connectedness value located in the bottom-right cell of the spillover table reveals that 24% of the total volatility across all currencies is attributable to cross-currency spillovers.

The table also enables a detailed breakdown of spillover contributions for each individual currency. For example, the DXY row in Table 2 shows that 5.5% of the volatility in the U.S. dollar originates from the InvEUR index, 10.67% from the MSCI EM index, and 12.41% from

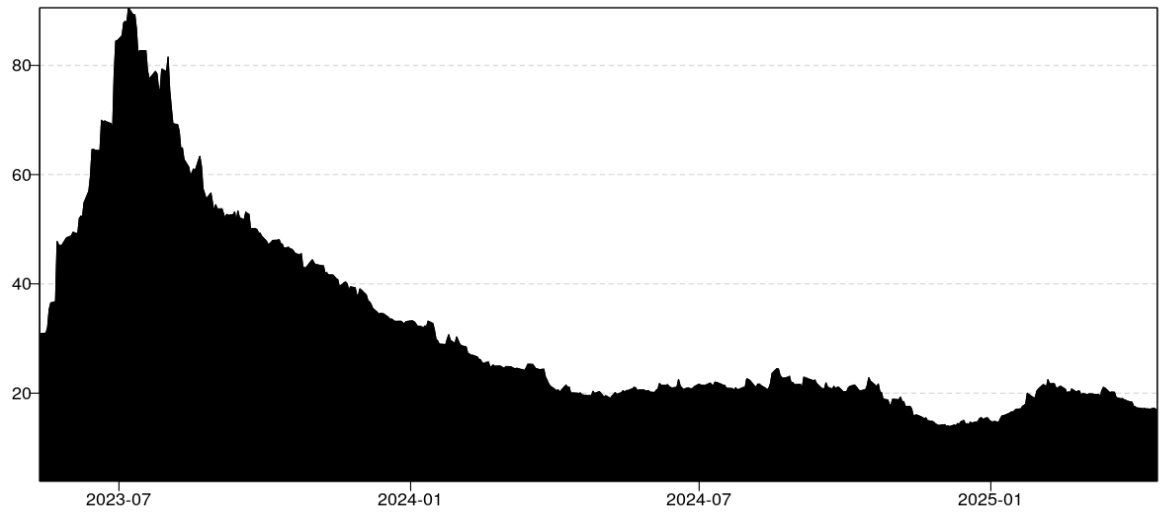
the CHF index. Similarly, the InvEUR row indicates that 5.01% of its volatility stems from DXY, 4.67% from MSCI EM, and 5.32% from CHF. For MSCI EM, 7.14% of the volatility is attributed to DXY, 4.18% to InvEUR, and 13.12% to CHF. Finally, the CHF row reveals that 13.79% of its volatility comes from DXY, 5.45% from InvEUR, and 7.64% from MSCI EM.

According to conventional wisdom, reserve currencies with higher convertibility and larger trading volumes exert greater influence over other currencies (Shahzad et al., 2020, p. 2). The spillover results of this study support that—particularly with regard to the DXY and CHF indices. Specifically, the U.S. dollar accounts for approximately 25.94% of the volatility observed in other currencies, while the Swiss franc is responsible for 30.85%. More precisely, 5.01% of euro volatility, 7.14% of emerging market currency volatility, and 13.79% of Swiss franc volatility can be attributed to spillovers from the U.S. dollar.

The total volatility transmitted from the euro and MSCI EM indices to other indices are measured at 15.12% and 22.98%, respectively. Further bilateral spillover values can be interpreted directly from Table 2.

The diagonal values of the spillover table represent the portion of volatility explained solely by each market's internal dynamics. These values range between 71% and 85%, indicating that the majority of volatility in the sampled currency indices is driven by domestic factors. This finding suggests that no single currency dominates the entire system, as most volatility remains endogenous to the individual markets.

Figure 2: Total Dynamic Connectedness



The results of the Dynamic Connectedness analysis are visualized in Figure 2. According to the figure, total volatility spillovers among the four currency indices fluctuate within a broad range,

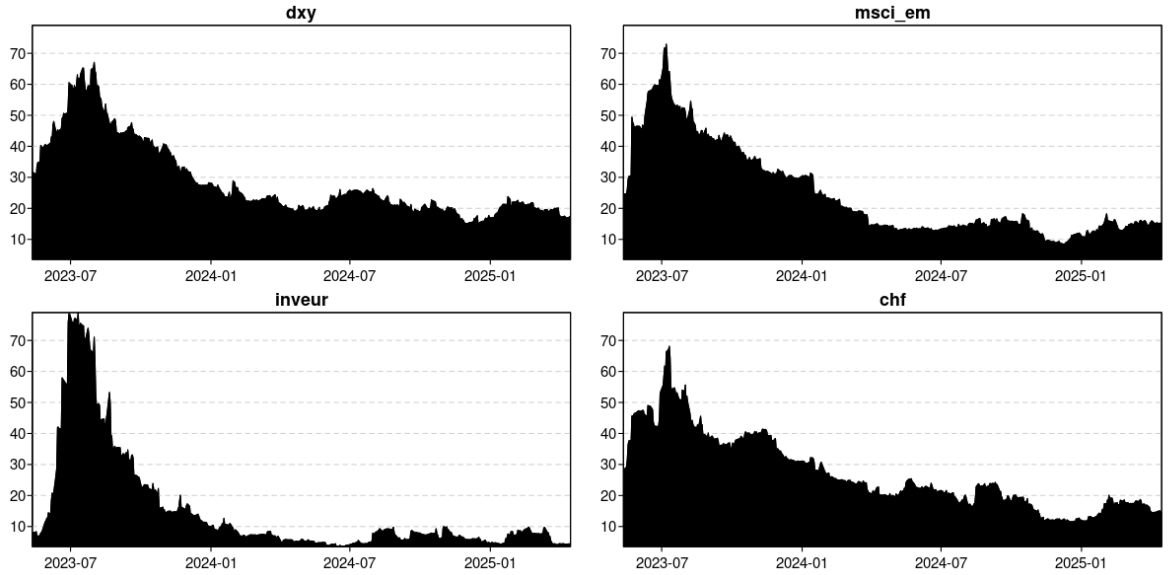
from approximately 15% to 90%. Consistent with the literature (e.g., Diebold & Yilmaz, 2012; Mittal et al., 2019; Shahzad et al., 2020), these results reinforce the notion that financial connectedness increases during periods of heightened financial turbulence.

Figure 2 illustrates a sharp rise in Total Dynamic Connectedness from the first half of 2023 to late July 2023. A key catalyst for this increase was the collapse of three U.S. banks in March 2023, triggered by the Federal Reserve's aggressive interest rate hikes—the most substantial in its history. The failure of Silicon Valley Bank (SVB), one of the largest banks in the U.S., caused severe financial stress across markets.

Following July 2023, Total Dynamic Connectedness began to decline, indicating a reduction in volatility transmission across currencies. This downward trend can be attributed to a combination of macroeconomic indicators and monetary policy signals. For instance, in August–September 2023, U.S. Consumer Price Index (CPI) data came in lower than expected, easing market concerns about future Fed rate hikes. In September 2023, the Federal Reserve signaled a potential pause in its tightening cycle, which significantly reduced financial market stress.

Subsequently, a drop in U.S. 10-year Treasury yields fostered expectations of a "soft landing" for the U.S. economy and contributed to a diminished perception of recession risk. Further support came from the European Central Bank (ECB), which hinted at softening its hawkish stance—reinforcing the prevailing sentiment of stabilization in global markets.

Figure 3: From-Dynamic Connectedness For 4 Monetary Indexes



Figures 3 to 5 visualize the "Connectedness from Others," "Connectedness to Others," and "Net Connectedness" values, allowing for a dynamic analysis of volatility transmission. Figure 3 presents the *From-Dynamic Connectedness* graph, which illustrates the time-varying volatility spillovers received by each market from the other three. As shown in Figure 3, the DXY, MSCI EM, and CHF indices have been exposed to relatively similar levels of volatility spillover throughout the entire sample period. In contrast, the InvEUR index appears to have experienced comparatively lower volatility transmission from the other three markets, particularly beginning in the second half of 2023.

Figure 4: To-Dynamic Connectedness For 4 Monetary Indexes

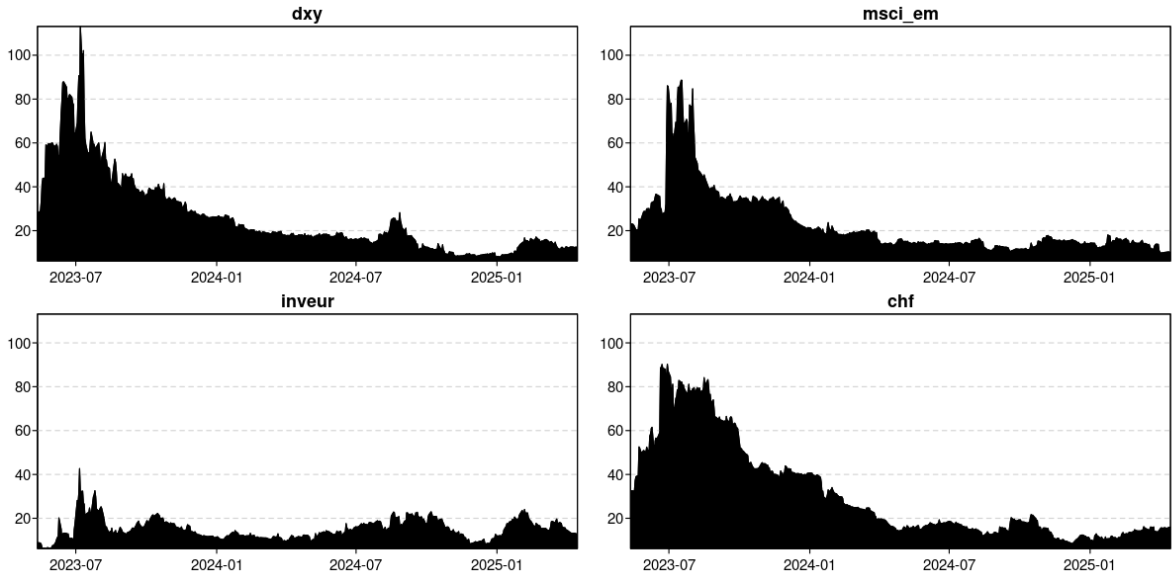
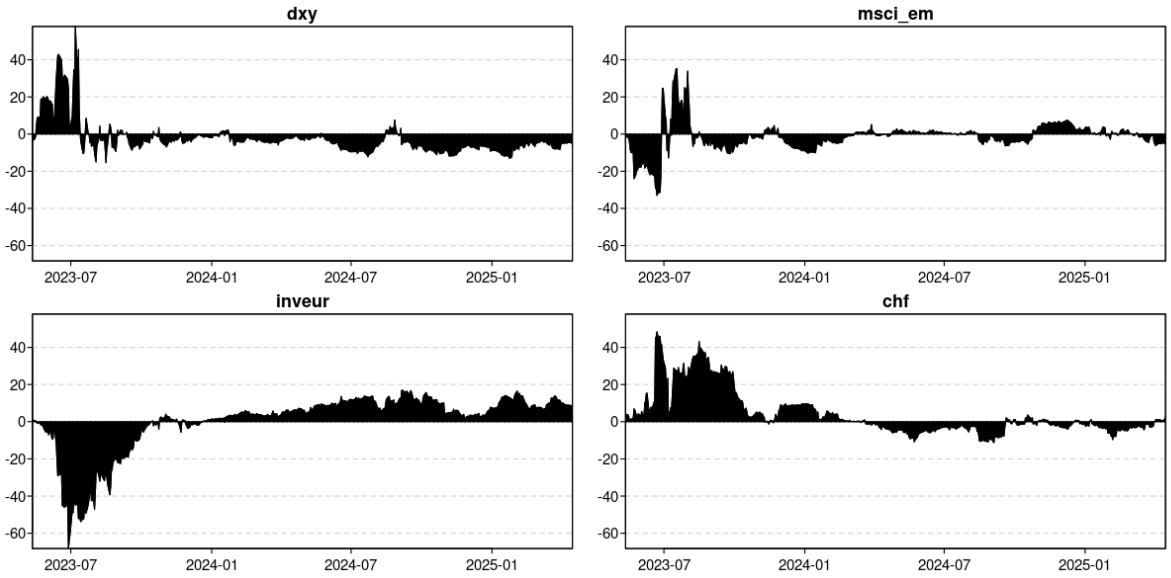


Figure 4 displays the *To-Dynamic Connectedness* graph, capturing the outgoing volatility spillovers transmitted from each currency index to the remaining three. A comparison of Figures 3 and 4 reveals a structural similarity between the two, indicating that DXY, MSCI EM, and CHF functioned as consistent sources of volatility throughout the sample period. The InvEUR index, however, transmitted relatively little volatility to the other indices, particularly during the 2023 U.S. banking crisis.

Figure 5: Net Spillovers For 4 Monetary Indexes



One of the most significant findings of the study is presented in Figure 5, which shows the *Net Spillovers* graph. Net Spillover values are calculated as the difference between "Connectedness to Others" and "Connectedness from Others" for each monetary index, providing a direct measure of Net Connectedness—that is, the net external shock each currency experiences. A positive Net Spillover value indicates that a given currency index is a net transmitter of volatility, whereas a negative value signifies it is a net receiver.

According to the Net Spillover findings in Figure 5, the DXY and CHF indices began the sample period as net transmitters of volatility but transitioned into net receivers in the later stages. The inverse holds true for the InvEUR index. The MSCI EM index displayed a more mixed pattern, alternating between transmitter and receiver roles depending on the period.

A review of the currency connectedness literature generally suggests that developed market currencies, particularly the U.S. dollar, tend to act as net volatility transmitters (Mensi, Ali, Vo, & Kang, 2022; Mo, Yang, & Chen, 2023). However, the findings of this study provide contrary evidence, indicating that from the second half of 2023 onwards, both the DXY and CHF indices

became net receivers of volatility. This shift is likely due to post-crisis liquidity measures implemented in the U.S., expectations that the Federal Reserve's rate hikes had peaked, and a general decline in financial stress.

Interestingly, Figure 5 also shows that, contrary to the prevailing narrative in the literature, emerging market currencies were not consistently net receivers of shocks. Instead, their net spillover status varied across time. A possible explanation for this is that emerging market economies have recently strengthened their foreign exchange reserves and adopted more proactive monetary policies. Meanwhile, the European Central Bank's (ECB) delayed and cautious response to the European energy crisis triggered by the Russia–Ukraine war may have rendered the InvEUR index more vulnerable to external shocks.

Taken together, the empirical findings of this study indicate that volatility spillovers declined over time, and the Total Connectedness value remained relatively low. This decline in volatility transmission plays a crucial role in enhancing financial market stability and making risks more predictable. As a result, investors can better interpret market dynamics and develop more effective strategies. In conclusion, reduced volatility spillovers serve as a key indicator that markets are operating in a healthier and more stable manner.

6. CONCLUSION

This study offers several important implications. First, insights into currency connectedness can assist investors in formulating effective risk management strategies for both currency-inclusive and currency-excluded portfolios. Second, the dynamic structure of currency connectedness revealed in this analysis provides valuable information that may guide portfolio diversification based on investors' risk appetite and investment planning. Given the time-varying nature of monetary volatility transmission, these insights may also help identify optimal timing strategies. Lastly, the strong linkages identified between currencies of economies with intensive trade relations can inform the design of more effective exchange rate policies.

The aim of this research was to contribute to the growing literature on currency connectedness between developed and emerging market currencies, and to provide a foundation for future studies. The findings support the *meteor shower hypothesis*, indicating that currency interdependence intensifies during periods of financial turmoil. However, this effect is not observed across the entire sample, which explains why the total connectedness value remains limited.

The study empirically finds a total connectedness level of 24%, suggesting that 24% of the volatility observed in the selected currency indices is attributable to external factors. The decline in volatility spillovers observed from the second half of 2023 onward serves as a strong indicator that financial contagion has decreased and that market functioning has improved. These developments underscore the significance of connectedness metrics in evaluating systemic risk and monetary stability in global financial markets.

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